20to2T5m WITH RESISTIVE MAGNETS: C TARGET
C TARGET STATION + C MODULE STUDIES

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20to2T5m WITH RESISTIVE MAGNETS: WITH 10 cm GAPS BETWEEN CRYOSTATS
******************************************************************************
# C TARGET STATION + BP#1 AZIMUTHAL TDPPD SIMULATIONS
[ ICEM = 1 MODE SIMULATIONS ].
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➡️ SIMULATIONS CODE: mars15 (10/14) [ USING MCNPDATA x-SECTION LIBRARIES FOR NEUTRON INTERACTIONS WITH KE < 14 MeV ]

➡️ NEUTRON ENERGY CUTOFF: 10^{-12} GeV

➡️ SHIELDING: 60% W + 40% He [ WITH STST VESSELS ]

➡️ B_z ( r = 0, z ) : 20 T [ z = 0.0 cm ] ---> 2.0 T [ z ~ 500.0 cm ]

➡️ C ROD RADIUS / ANGLE: 0.58 cm / 59 mrad (~ 3.38 degrees ) [-37.5 < z < 37.5 cm]
    C density = 2.26
➡️ PROTON BEAM POWER: 4.0 MW

➡️ PROTON ENERGY: E = 6.75 GeV (Kinetic energy)

➡️ PROTON BEAM PROFILE : GAUSSIAN, σ_x = σ_y = 0.2588 cm [ 5 micron emmitance ]

➡️ PROTON BEAM LAUNCH : (x0, y0, z0) = (-2.02835, 5.44336, -100.0 ) cm
    (dcx0, dcyo, dcz0) = (0.035168, -0.045786, -0.998332 )
➡️ EVENTS IN SIMULATIONS : N_p = 2E5 / 3E5 ( STEP:10^-2 / 10^-3 / 10^-4 )
20to2T5m: yz CROSS SECTION (x = 0.0 cm) WITH GEOMETRY DIMENSIONS / PARAMETERS.

- **SC#1-2**: IR = 120 cm
- **SC#3-10**: IR = 100 cm
- **BP#3**: IR = 23 cm, 2 cm STST
- **BP#1**: IR = 13 cm
- **RS#1-5**: IR = 15 cm, OR = 46 cm
- **BeWind#1-4**: DOUBLE 0.5 cm He GAP 1.0 cm
- **CRYO#1-2/2-3**: 10 cm GAPS: z ~ 420, 1000 cm
- **C TARGET / DUMP**: -37.5 < z < 37.5 cm / 37.5 < z < 112.5 cm

Geometric Dimensions:

- **r**: 120.0 < r < 150.0 cm, dr = 10.0 cm
- **z**: -55.0 < z < 185.0 cm, dz = 20.0 cm
- **φ**: 0.0 < φ < 360.0 deg, dφ = 30 deg

Total: 432 "pieces"
CROSS SECTION (x = 0.0 cm) WITH B FIELD MAP AND CENTROID TRAJECTORY WITHOUT C TARGET/DUMP PRESENT. THE BEAM WILL REACH THE CRYO#1 UPSTREAM Be WINDOW (AT z ~ 430 cm) NEAR THE BOTTOM AREA. POWER LEAK FLOW mars1510/mars1514.

[ z = -200.0, 1500.0 cm, R = 210.0 cm SURFACE DETECTORS ]

** PRINCETON **
** (NO MASS )

R = 210.0 cm
TOT ~ 260 kW
p:1 kW / n:187 kW

** PRINCETON **
** (NO MASS )

R = 210.0 cm
TOT ~ 66 kW
p:0.3 kW / n:8 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 263 kW
p:2 kW / n:203 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 380 kW
p:166 kW / n:37 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 338 kW
p:152 kW / n:32 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 8.53 kW
p:1.7 kW / n:0.31 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 155 kW
p:21 kW / n:109 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 130 kW
p:26 kW / n:88 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 150 kW
p:21 kW / n:109 kW

** PRINCETON **

R = 210.0 cm
TOT ~ 8.53 kW
p:1.7 kW / n:0.31 kW

Aspect Ratio: Y:Z = 1:4.54545
IDS120j, 20to2T5m: yz CROSS SECTION (x = 0.0 cm) WITH AZIMUTHALLY AVERAGE TDPD DISTRIBUTION IDS120j WITH Hg TRGT (LEFT) AND 20to2T5m WITH C TRGT (RIGHT)
BP#1 SEGMENTATION DETAILS: $yz$ AT $x = 0.0$ cm [LEFT] AND $xy$ AT $z = 0.0$ cm [RIGHT] CROSS SECTION WITH SEGMENTATION DETAILS OF INNER TUBE.

$13.0 < r < 13.5$ cm  \hspace{1cm} dr = 0.5$ cm  \hspace{1cm} N_r = 1$ bins

- $39.0 < z < 121.0$ cm  \hspace{1cm} dz = 10.0$ cm  \hspace{1cm} N_z = 16$ bins

$0.0 < \varphi < 360.0$ deg.  \hspace{1cm} d\varphi = 30$ deg.  \hspace{1cm} N_\varphi = 12$ bins

$N_{tot} = 192$ "pieces"
BP#1 : TDPD AZIMUTHAL DISTRIBUTION FOR 12 ANGLES FROM mars1510 ( DESKTOP )

4 MW beam power

N= 200,000     STEP =0.01 cm

PEAK: 3464.28 mW/g ( r, z, phi ) = ( 13.25  66.0  255 )
TDP: 101.41 kW (PIECES) vs. 113.48 kW ( TUBE 2 )

N=300,000     STEP= 0.01 cm

PEAK: 3432.28 mW/g ( r, z, phi ) = ( 13.25  56.0  255 )
TDP: 101.407 kW (PIECES) vs. 112.83 kW ( TUBE 2 )
BP1: TDPD AZIMUTHAL DISTRIBUTION FOR 12 ANGLES FROM mars1510 (DESKTOP)

4 MW beam power

\[ \text{N}= 200,000 \quad \text{STEP} = 0.001 \text{ cm} \]

\[ \text{N}= 300,000 \quad \text{STEP} = 0.001 \text{ cm} \]

PEAK: \(3215.99 \text{ mW/g} \quad (r, z, \phi) = (13.25, 76.0, 255)\)

TDP: 96.51 kW (PIECES) vs. 113.54 kW (TUBE 2)

PEAK: \(3258.06 \text{ mW/g} \quad (r, z, \phi) = (13.25, 66.0, 255)\)

TDP: 97.28 kW (PIECES) vs. 114.31 kW (TUBE 2)
BP#1 : TDPD AZIMUTHAL DISTRIBUTION FOR 12 ANGLES FROM mars1514 (PRINCETON)

N= 200,000      STEP = 0.001 cm

TDP: 101.41 kW (PIECES) vs. 113.48 kW (TUBE 2)

N= 300,000      STEP = 0.001 cm

TDP: 101.407 kW (PIECES) vs. 112.83 kW (TUBE 2)

PEAK: 3255.1 mW/g (r, z, phi) = (13.25, 56.0, 255)

TDP: 97.31 kW (PIECES) vs. 108.86 kW (TUBE 2)

PEAK: 3183.99 mW/g (r, z, phi) = (13.25, 56.0, 255)

TDP: 97.21 kW (PIECES) vs. 108.74 kW (TUBE 2)

4 MW beam power
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### Deposited Power in Different Parts of the Target Station in kW

<table>
<thead>
<tr>
<th>Part</th>
<th>Deposited Power (kW)</th>
<th>Deposited Power (kW)</th>
<th>Deposited Power (kW)</th>
<th>Deposited Power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job in Princeton</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JOB IN PRINCETON DEPENDS ALSO ON QUE / WAITING TIME. mars1514 + new Princeton cluster much faster than mars1512</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) SC#1:</td>
<td>0.807</td>
<td>0.796</td>
<td>0.812</td>
<td>0.818</td>
</tr>
<tr>
<td>A) SC#2:</td>
<td>0.339</td>
<td>0.347</td>
<td>0.351</td>
<td>0.334</td>
</tr>
<tr>
<td>A) SC#3:</td>
<td>0.140</td>
<td>0.130</td>
<td>0.141</td>
<td>0.129</td>
</tr>
<tr>
<td>A) SC#4:</td>
<td>0.011</td>
<td>0.010</td>
<td>0.009</td>
<td>0.011</td>
</tr>
<tr>
<td>A) SC#5:</td>
<td>0.015</td>
<td>0.015</td>
<td>0.015</td>
<td>0.015</td>
</tr>
<tr>
<td>TOTAL DP SC#1-10:</td>
<td>1.335</td>
<td>1.317</td>
<td>1.347</td>
<td>1.325</td>
</tr>
<tr>
<td>B) DP IN RS COILS</td>
<td>RS#1: 504.89</td>
<td>502.28</td>
<td>502.10</td>
<td>505.30</td>
</tr>
<tr>
<td>B) DP IN RS COILS</td>
<td>RS#2: 190.58</td>
<td>190.81</td>
<td>190.99</td>
<td>191.11</td>
</tr>
<tr>
<td>B) DP IN RS COILS</td>
<td>RS#3: 89.48</td>
<td>88.89</td>
<td>88.95</td>
<td>89.36</td>
</tr>
<tr>
<td>B) DP IN RS COILS</td>
<td>RS#4: 49.51</td>
<td>49.55</td>
<td>49.46</td>
<td>49.53</td>
</tr>
<tr>
<td>B) DP IN RS COILS</td>
<td>RS#5: 27.37</td>
<td>27.54</td>
<td>27.42</td>
<td>27.45</td>
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<tr>
<td>TOTAL: 861.83</td>
<td>859.07</td>
<td>858.93</td>
<td>862.76</td>
<td>885.53</td>
</tr>
<tr>
<td>C) DP IN SHIELDING</td>
<td>SH#1: 343.88</td>
<td>343.41</td>
<td>342.52</td>
<td>342.75</td>
</tr>
<tr>
<td>C) DP IN SHIELDING</td>
<td>SH#2: 890.66</td>
<td>895.40</td>
<td>895.40</td>
<td>889.48</td>
</tr>
<tr>
<td>C) DP IN SHIELDING</td>
<td>SH#3: 42.54</td>
<td>42.44</td>
<td>42.60</td>
<td>43.03</td>
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<tr>
<td>TOTAL: 1277.08</td>
<td>1281.26</td>
<td>1280.52</td>
<td>1275.27</td>
<td>1393.78</td>
</tr>
<tr>
<td>D) DP IN VESSELS</td>
<td>SHVS#1: 130.61</td>
<td>129.42</td>
<td>130.90</td>
<td>130.61</td>
</tr>
<tr>
<td>D) DP IN VESSELS</td>
<td>SHVS#2: 174.58</td>
<td>173.75</td>
<td>172.98</td>
<td>173.10</td>
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<tr>
<td>D) DP IN VESSELS</td>
<td>SHVS#3: 3.05</td>
<td>3.07</td>
<td>3.05</td>
<td>3.10</td>
</tr>
<tr>
<td>TOTAL: 308.24</td>
<td>306.24</td>
<td>306.93</td>
<td>306.80</td>
<td>306.16</td>
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<tr>
<td>E) DP IN C TRGT</td>
<td>C TRGT: 114.43</td>
<td>114.43</td>
<td>114.07</td>
<td>114.01</td>
</tr>
<tr>
<td>E) DP IN C DUMP</td>
<td>C DUMP: 7.60</td>
<td>7.60</td>
<td>7.54</td>
<td>7.52</td>
</tr>
<tr>
<td>F) DP IN Be WINDOW 1</td>
<td>Be WINDOW 1: 3.24</td>
<td>3.23</td>
<td>3.20</td>
<td>3.19</td>
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<tr>
<td>F) DP IN Be WINDOW 2</td>
<td>Be WINDOW 2: 1.74</td>
<td>1.76</td>
<td>1.70</td>
<td>1.71</td>
</tr>
<tr>
<td>F) DP IN Be WINDOW 3</td>
<td>Be WINDOW 3: 1.65</td>
<td>1.66</td>
<td>1.60</td>
<td>1.61</td>
</tr>
<tr>
<td>F) DP IN Be WINDOW 4</td>
<td>Be WINDOW 4: 1.40</td>
<td>1.40</td>
<td>1.34</td>
<td>1.34</td>
</tr>
<tr>
<td>TOTAL DP: 3,122.33</td>
<td>3,122.49</td>
<td>3,115.65</td>
<td>3,116.51</td>
<td>3,231.13</td>
</tr>
</tbody>
</table>

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**Deposited power = kinetic energy/sec**

**4 MW beam power**
IDS120j: \( yz \) CROSS SECTION WITH THE PROTON BEAM CENTROID P12 TRAJECOTRY SHOWING (RIGHT) AND WITHOUT SHOWING (LEFT) THE Hg POOL AND Hg JET.

# PROTONS ENTER THE Hg POOL AT \((x, y, z)\sim(-1.61, -15.00, 104.66)\) cm AND WILL BE STOPPED BY THE SIDE (SEMICIRCULAR) WALL AT \((x, y, z)\sim(-19.39, -33.26, 358.80)\) cm (\(~10\) cm BEFORE THEY REACH THE RIGHT SIDE FLANGE OF Hg MODULE) COVERING A DISTANCE \(~255.41\) cm \(~17\) IL (1 IL \(~15\) cm).

# IS IT POSSIBLE FOR POOL TO BE SORTER AND FILL THE REST OF THE UPSTREAM VOLUME WITH SHIELDING?

# NOTICE: R1, HU (HL?) DIMENSIONS OF Hg MODUL ARE DETERMINED FROM THE SPACE NEEDED FOR THE PROTON BEAM TRAJECTORY. DIFFERENT INJECTION POINTS WILL PROBABLY REQUIRE DIFFERENT VALUES FOR THESE PARAMETERS.
IDS120j: yx (AT z = 200 cm) (LEFT) AND xz (RIGHT) CROSS SECTION WITH THE PROTON BEAM CENTROID P12 TRAJECTORY.